



JONES NICHOLSON PTY LTD
CONSULTING ENGINEERS

Report on Rail Tunnel Implications

Proposed Development 7-9 Gibbons Street, Redfern

**For
Lawson Square Pty Ltd**

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1. Introduction

- 1.1 Acting in accordance with instructions received from Candalepas Architects, Jones Nicholson Engineers have prepared this report to advise on appropriate construction methods for the residential tower and in particular the basement construction. The report is to address the impact of the development on the existing and proposed rail tunnels in the area and also the impacts of rail activities on the development (noise and vibration) as listed in item 7 of the Director General's Requirements.
- 1.2 The proposed building comprises up to 8 levels of basement parking, 2 levels of retail space at ground and 1st floors, a commercial floor at level 2 and 15 floors of residential units. The basement occupies the full site and measures approx 50m x 30m and is up to 26m deep. The lowest basement floor is at approx RL. 0.81m.
- 1.3 The site is bounded by Redfern RSL to the North, William Lane to the East, Marian Street to the South and Gibbons Street to the West.
- 1.4 A redevelopment proposal of the Redfern RSL site is a current Part 3a application to NSW Department of Planning.
- 1.5 This report has been produced based on the following documentation:
 - Architectural drawings DA1101, DA1102 and DA1201 prepared by Candalepas Architects.
 - Department of Railways NSW drawings No.4SS-4001, 6005, 6028, 6029 and 6201 showing the existing Illawarra Relief Line tunnels.
 - Railcorp Corridor Protection drawings TTSRCP-401 and 402 showing the proposed CBD rail link tunnels.
 - Geotechnical assessment by SMEC Testing Services Pty Ltd dated April 2009 (ref 09/0326).

2. Rail Tunnels

- 2.1 The Illawarra Relief line tunnels run North South adjacent to the site in Gibbons Street refer to drawing S01 and S02. The nearer tunnel centre line is approx 13.5m from the site boundary. The invert of the tunnel is at approx. RL 17.37m which is about 16.7m above the proposed excavation level for the basement.
- 2.2 The proposed CBD link tunnels are located to the East of the site refer to drawing S01 and S02. The closer tunnel centre line is about 40m from the site boundary. The invert of the tunnel is at approx. RL-27.6m. which is about 28.3m below the proposed excavation level.

3. Ground Conditions

- 3.1 The geotechnical report prepared for the site indicates that the ground strata comprises:
- Shallow layer of fill up to 1m deep
 - Clay layer from 1m to 5.5m.
 - Shale layer from 5.5m to 28.8m.
 - Sandstone below 28.8m.

4. Proposed Building Construction

- 4.1 The proposed structure for the new tower comprises:
- Concrete floor slabs at all levels
 - Concrete columns, lift cores and stair walls
 - Concrete pad footings to columns and strip footings for walls.
 - Concrete soldier pile walls to basement perimeter.
 - Temporary anchors to basement walls.
- 4.2 Stability of the building will be achieved using the lift and stair walls as bracing systems.
- 4.3 Because of the proposed basements on the adjacent RSL site and also the adjacent Rail tunnels all stability loads will be taken down to foundation level. No lateral loads will therefore be placed on the Rail tunnels.

5. Railcorp Requirements

- 5.1 NSW State Environment Planning Policy (Infrastructure) 2007 requires all development applications for developments within 25m of the rail corridor to be referred to Railcorp for approval.
- 5.2 Railcorp's requirements are set out in Railcorp document ESC 380 and Railcorp's geotechnical brief. The requirements relevant to this project include:

Railcorp standard ESC 380:

- Clause 4.1 – Temporary components
- Clause 5.4 – Noise and Vibration
- Clause 5.5 – Stray currents and electrolysis from rail operations
- Clause 6.1 – Demolition, earthworks and construction impacts.

Railcorp Geotechnical brief:

- Accurately plot location of rail tunnels.
- Produce dilapidation surveys for the rail tunnels.
- Submit work method statements for excavation and construction.
- Monitor existing rail tunnels during construction.

- Geotechnical investigation and assessment.
- Produce 3D finite element analysis of the ground.
- Limit vertical loads on tunnel roofs.
- No lateral loading to be applied to tunnel walls.
- Take Rail easements (6m from tunnel centre line) into account.

6. Proposed methods of meeting Railcorp's requirements

6.1 Design of temporary components.

All temporary works components will be designed to have a minimum service life of 10 years in accordance with 4.1 of ESC380.

6.2 Noise and vibration.

An acoustic report dated 30 August 2009 has been prepared by Renzo Tonin Associates dealing with the noise and vibration issues.

6.3 Stray Currents and Electrolysis.

An electrolysis report dated 15 September 2009 has been prepared by Corrosion Control Engineering dealing with stray currents and electrolysis.

6.4 Demolition, earthworks and construction impacts.

The basement construction concept is detailed in the attached drawings S01 and S02. The concept aims to produce a solution which minimises the effects on the surrounding ground and includes:

- Stiff shoring solution.
- Anchors located outside the zone of influence of the basement excavation.
- Loads transmitted to the founding strata below the level of the nearby existing tunnels.

6.5 Accurately plot location of rail tunnels.

The concept shoring drawings have been produced based on scanned versions of Railcorp drawings as listed in 1.5 above. Before proceeding with the detailed design, accurate "as constructed" documentation will be requested from Railcorp so that the location of the tunnels can be confirmed.

6.6 Produce dilapidation surveys for the rail tunnels.

Dilapidation reports will be prepared to meet Railcorp's requirements.

6.7 Work method statements for excavation and construction.

Detailed work method statements will be developed as part of the detailed design and submitted to Railcorp for approval.

6.8 Monitor existing rail tunnels during construction.

Monitoring of the rail tunnels will be carried out as part of the construction process. The extent and type of monitoring to be agreed with Railcorp.

6.9 Geotechnical investigation and assessment.

Further geotechnical investigation will be undertaken before detailed design of the shoring and foundations. The geotechnical engineers assessment will include soil properties, bedding planes, locked in stresses, construction methodology, movement etc..

6.10 Produce finite element analysis of the ground.

Finite analysis of the effects of the development on the ground and tunnels will be carried out as part of the detailed design to satisfy Railcorp's requirements.

6.11 Vertical loads on tunnel roofs.

No loads will be applied to the roof of the existing Illawarra relief line tunnels by the development. The proposed City Link tunnels lie outside the zone of influence of the development's foundations and will therefore not have any loading from the development imposed on them.

6.12 No lateral loading to be applied to tunnel walls.

A stiff shoring system is proposed anchored below the level of the tunnel walls. All stability loads for the new building will be taken down to the bottom of the excavation to avoid transferring lateral loads to the soil between the basement and tunnels.

6.13 Rail easements.

The easement for the Illawarra Relief Lines extends 6m from the centreline of the tunnels (refer to S02). The depth of the easement has not been confirmed at this stage but it is likely to continue for many meters below the existing tunnels.

None of the construction, with the exception of the temporary ground anchors, extends into the easement.

The temporary anchors shown on drawing S02 do extend past the line of the easement and into the rail corridor but are located below the tunnels. It is not feasible to use short anchors located outside of the easement due to the depth of the basement.

7. Discussions with Railcorp

7.1 A meeting was held between Peter Boyden of Railcorp and Mark Molloy of Jones Nicholson on 28th September 2009 to review the initial structural proposals for the basement construction. The items listed below reflect Railcorp's initial reaction to the proposal after viewing the drawings for the first time during the meeting.

7.2 Railcorp highlighted the importance of the following items which would need careful consideration before any solution could be approved:

- The extent of the Rail Easement (line and depth) must be confirmed by a surveyor.
- Providing temporary anchors extending into the rail easement would require an anchor deed between the developer and Railcorp. Fees are payable for each anchor extending into the easement.
- Providing temporary anchors close to the base of the tunnels would require careful setting out to ensure anchors did not damage the tunnel structure. An adequate buffer would also be required to provide an additional margin of safety. Railcorp would require that the tunnel line and level is surveyed and that each anchor is drilled under the supervision of a surveyor to ensure the correct level and anchor inclination is achieved.
- The developer's engineer must establish that given the close proximity of the tunnels and the existing soil conditions other solutions not including temporary anchors into the rail easement are not viable and that the temporary anchors serve to protect the structural integrity of the existing rail infrastructure.
- An e-mail from Railcorp dated 29 September 2009 following on from the meeting is attached – refer to Appendix B.

8. Conclusion

- 8.1 The construction of the above development can be achieved safely without impacting negatively on the existing or proposed rail tunnels.
- 8.2 Further geotechnical investigation and assessment will be required to finalise the design of the basement shoring. Sections 6 and 7 outline the items to be addressed to satisfy Railcorp before the development proceeds.
- 8.3 Getting approval for the use of temporary anchors within the easement and under the existing tunnels will require detailed negotiations with Railcorp. It will be necessary to convince Railcorp that the anchored solution is the best method available to protect the existing rail tunnels.
- 8.4 The anchored solution outlined in the attached drawings provides the best protection for the existing tunnels. The advantages of the anchored solution are:
- Each temporary anchor will be load tested during construction as part of the standard stressing operation. This load testing will prove the load carrying capacity of the system.
 - The load in each anchor will be calculated to achieve an “at rest” condition in the soil behind the shoring wall.
 - Monitoring of the shoring wall can be carried out to demonstrate that the soil behind the wall remains in the “at rest” condition. If any movement does occur it will be possible to restress the anchors to maintain the “at rest” condition of the soil.
 - In the long term the basement floors will provide propping to the shoring walls and replace the temporary anchors. De-stressing the anchors can be delayed by several months to allow the normal concrete shrinkage in the floors to occur. The small gaps between the shoring walls and the floors can then be filled with grout to ensure a tight fit and minimize movement once the anchors are de-stressed.
 - The anchored solution will provide the stiffest shoring solution with minimal deflection thereby best protecting the Rail infrastructure.

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Appendix A

Concept Shoring Drawings

S01 – Basement and Rail Line Plan

S02 – Section through Basement and rail lines

Appendix B

Correspondence with Railcorp

- e-mail from Railcorp dated 29 September 2009